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PRELIMINARY LISTS OF TERMS FOR THE ARC AND SPARK SPECTRA OF TUNGSTEN

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ABSTRACT

The new large quartz-prism spectrograph of the National Bureau of Standards has been used to photograph the arc and spark spectra of tungsten in the ultraviolet between 3100 and 2100 Å. The wave-length data derived from these observations and also the Zeeman effect observations made with the same instrument, have made it possible to establish the low terms 6D and 6S of W_{II} , together with several other metastable terms whose identity is not yet certain. The *raie ultime* of W_{II} is probably the intense line at 2204.49 Å. In W_I , 89 new levels have been found. The g -values, derived from new Zeeman effects, are given for 37 levels of W_I .

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I. INTRODUCTION

Because of their complex character, the spectra of tungsten and uranium, in the sixth column of the periodic system, have been only incompletely described. This circumstance has been largely responsible for the delay in working out the term structure of these spectra. In fact, no terms for uranium spectra are as yet known; but for the first spectrum of tungsten a beginning was made by Laporte ¹ 13 years ago, when he announced the low 5D and 7S terms of W_I , and showed that the two lowest components of 7D actually lie below 7S , contrary to the term arrangement of the analogous spectra Cr_I and Mo_I . With the help of new wave-length and Zeeman effect data, the low terms of W_{II} have now been found. It is the purpose of this paper to communicate the new terms, to report the results of some Zeeman effect observations that have been made of ultraviolet lines, and to give the classification of nearly 500 lines that originate in the low terms and also in some metastable terms lying considerably higher than the ground term.

II. EXPERIMENTAL

Shortly after Laporte made known his results for the arc spectrum, I began a search among the spark lines of tungsten for the 6D and 6S terms of W_{II} , to correspond with the similar terms which Kiess

¹ O. Laporte, *Naturwissenschaften* **13**, 627 (1925).

and Laporte² had established for Cr II. But these initial efforts proved fruitless owing to the inadequate descriptions of the ultraviolet portions of the tungsten spectra then available. Accordingly, I undertook to reobserve these spectra, using for this purpose the Hilger E1 quartz spectrograph of the National Bureau of Standards, which could be effectively employed down to 1900 Å. Subsequently, these earlier spectrograms have been supplemented with a new series obtained by C. C. Kiess with the large quartz spectrograph, and also with the 20,000 lines per-inch concave grating spectrograph. Both of these instruments have been described elsewhere in this Journal.³

In addition to the spectrograms that were obtained for wavelength measurement, Kiess has also made a set of Zeeman effect observations of the ultraviolet tungsten spectra, using the same large quartz spectrograph in conjunction with the water-cooled magnet of the National Bureau of Standards. Equipped with ferro-cobalt pole-pieces, this magnet supplied a field of 34,500 gauss across a 6-mm gap of circular area 1 cm in diameter. A current of 150 amp was required to maintain the field.

Small rods of very pure tungsten metal were used as electrodes in the arcs and sparks that served as light sources. Each spectrogram was exposed also to iron or copper arcs to obtain the necessary standards for the reduction of the measurements. The wave lengths of the lines used as standards were taken from the lists of Burns and Walters,⁴ except for two observations of the region 3750 to 3000 Å, for which the large grating was used. Here the standards used in the reductions were calculated values of tungsten arc lines observed by Belke. The reason for this procedure was to fit the new wave lengths to the scale of Belke's observations, which Laporte and Mack have used in setting up their system of levels in the analysis of W I.

The spectrograms were all measured and reduced according to the usual procedure. The earlier plates were measured on the large comparator of the Bureau, but the later plates were measured on the comparator of the Physics Department of Marquette University.

III. RESULTS

1. FIRST SPARK SPECTRUM OF TUNGSTEN W II

In tables 1 and 2 are given the terms which, thus far, have been found for W II. The character of the terms ⁶D and ⁶S is established with certainty by the Zeeman effects. These terms arise, respectively, from the electron configurations d^4s and d^5 , for which LS -coupling holds, as indicated by the excellent agreement between the observed g -values and those calculated from Landé's theory.⁵ For the terms which are clearly identified the usual symbols are employed; the other terms, in accord with a scheme adopted by Laporte and Mack for W I, are designated by the first two significant figures of their numerical values in the case of the even terms, and by the first three figures in the case of the odd terms, with subscripts denoting the inner quantum numbers, J .

² C. C. Kiess and O. Laporte, *Science* **63**, 234 (1926).

³ C. C. Kiess and E. Z. Stowell, *BS J. Research* **12**, 459 (1934) RP671. W. F. Meggers and K. Burns, *BS Sci. Pap.* **18**, 191 (1923) S 441.

⁴ K. Burns and F. M. Walters, *Pub. Allegheny Obs.* **8**, 27 and 39 (1931).

⁵ A. Landé, *Z. Physik.* **15**, 189 (1923).

In table 3 are listed 500 lines that have been classified on the basis of the terms in tables 1 and 2. Following each wave length are, in order, the estimated intensities of the lines in the arc and spark sources, the wave number, the term combination, and, lastly, the observed Zeeman effect. For all the lines, except the first four, the estimated intensities are from National Bureau of Standards spectrograms. For the first four lines the intensities B are from Belke,⁶ and the intensities E from Exner and Hascheck. The letters following the intensities describe the following characteristics of the lines: a , classified also in W I; b , broadened; c , complex; d , double; r , reversed; p , apparent pole-effect or transverse variation of intensity (pr reversed only at end of line); l , displaced toward the red; and v , displaced toward the violet.

TABLE 1.—Even terms of W II

Term symbol	Term value	g -value	
		observed	theoretical
d^4s $^6D_{0\frac{1}{2}}$	0. 0	3. 20	3. 33
$^6D_{1\frac{1}{2}}$	1518. 8	1. 86	1. 87
$^6D_{2\frac{1}{2}}$	3172. 7	1. 64	1. 66
$^6D_{3\frac{1}{2}}$	4716. 4	1. 58	1. 59
$^6D_{4\frac{1}{2}}$	6147. 1	1. 56	1. 56
d^5 $^6S_{2\frac{1}{2}}$	7420. 5	1. 94	2. 00
$^4F_{1\frac{1}{2}}$	8711. 3	0. 64	0. 40
$08_{0\frac{1}{2}}$	8832. 7	2. 5	
$13_{0\frac{1}{2}}$	13173. 3	0. 48	
$10_{1\frac{1}{2}}$	10592. 5		
$14_{1\frac{1}{2}}$	14634. 4	1. 2	
$11_{2\frac{1}{2}}$	11301. 0	1. 1	
$13_{2\frac{1}{2}}$	13434. 2	1. 4	
$14_{2\frac{1}{2}}$	14967. 9		
$16_{2\frac{1}{2}}$	16234. 9		
$23_{2\frac{1}{2}}$	23450. 4		
$13_{3\frac{1}{2}}$	13412. 0	1. 2	
$15_{3\frac{1}{2}}$	15147. 0	1. 0	
$16_{3\frac{1}{2}}$	16589. 7	1. 3	
$20_{3\frac{1}{2}}$	20039. 8		
$14_{4\frac{1}{2}}$	14857. 2	1. 2	
$16_{4\frac{1}{2}}$	16553. 1	1. 1	
$19_{4\frac{1}{2}}$	19070. 9		
$20_{4\frac{1}{2}}$	20780. 5		
$23_{4\frac{1}{2}}$	23234. 8		
$17_{5\frac{1}{2}}$	17437. 1	1. 2	
$20_{5\frac{1}{2}}$	20534. 4		

⁶ M. Belke, Z. wiss. Phot. **17**, 132 and 145 (1918).

TABLE 2.—*Odd terms of W II*

Term symbol	Term value	Observed <i>g</i> -value	Term symbol	Term value	Observed <i>g</i> -value
361 _{0½}	36165. 3	0. 67	448 _{3½}	44877. 1	1. 32
385 _{0½}	38576. 3	1. 67	461 _{3½}	46175. 4	
444 _{0½}	44455. 2	. 2	488 _{3½}	48830. 7	1. 0
454 _{0½}	45457. 0	. 4	491 _{3½}	49124. 5	
523 _{0½}	52355. 0		518 _{3½}	51863. 0	. 9
391 _{1½}	39129. 4	1. 14	522 _{3½}	52275. 5	
422 _{1½}	42298. 1	1. 50	529 _{3½}	52901. 7	
449 _{1½}	44911. 7	1. 24	533 _{3½}	53338. 0	
471 _{1½}	47180. 0	1. 04	577 _{3½}	57730. 0	
533 _{1½}	53329. 7		592 _{3½}	59276. 8	
534 _{1½}	53423. 0		598 _{3½}	59869. 1	
541 _{1½}	54137. 3	1. 6	447 _{4½}	44758. 0	1. 30
560 _{1½}	56084. 3		464 _{4½}	46493. 4	1. 32
420 _{2½}	42049. 4	1. 30	491 _{4½}	49181. 0	
443 _{2½}	44354. 8	1. 40	508 _{4½}	50863. 1	1. 2
463 _{2½}	46355. 4	1. 2	533 _{4½}	53370. 0	1. 2
474 _{2½}	47413. 3	1. 14	540 _{4½}	54056. 6	
482 _{2½}	48284. 6	1. 38	553 _{4½}	55392. 5	
492 _{2½}	49242. 2	1. 5	593 _{4½}	59399. 4	
514 _{2½}	51438. 0	1. 3	514 _{5½}	51495. 0	1. 4
531 _{2½}	53113. 6	1. 1	549 _{5½}	54958. 6	1. 1
547 _{2½}	54704. 7		588 _{5½}	58891. 8	1. 2
567 _{2½}	56768. 7		602 _{5½}	60218. 9	
568 _{2½}	56875. 1		612 _{5½}	61240. 8	1. 1
423 _{3½}	42390. 2	1. 16	615 _{5½}	61589. 6	

TABLE 3.—*Classified lines of W II*

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
4348. 13	B2	E8	22992. 0	13 _{0½} —361 _{0½}	(0.00) 0.57 J
4175. 63	E6	E8	23941. 8	14 _{1½} —385 _{0½}	(0.24) 1.49, 1.96 Be
3935. 44	B1	E10	25403. 0	13 _{0½} —385 _{0½}	(0.59) 1.07 J
3851. 57	B1	E6	25956. 1	13 _{0½} —391 _{1½}	(0.00) 1.53 J
3716. 08	10	50	26902. 4	15 _{3½} —420 _{2½}	
3691. 49	10 <i>l</i>	4	27081. 6	14 _{2½} —420 _{2½}	
3688. 34		4	27104. 8	19 _{4½} —461 _{3½}	
3657. 88	10	30	27330. 5	14 _{2½} —422 _{1½}	
3657. 59	40	120	27332. 6	08 _{0½} —361 _{0½}	(0.88) 1.56 J
3652. 14	12 <i>b</i>	10 <i>b</i>	27373. 4	20 _{3½} —474 _{2½}	
3646. 60	10	40	27415. 0	14 _{1½} —420 _{2½}	(0.00) 1.37 J
3645. 61	10	40	27422. 5	19 _{4½} —464 _{4½}	
3641. 42	40	150	27454. 0	14 _{2½} —423 _{3½}	
3630. 98		5	27533. 0	⁴ F _{1½} —361 _{0½}	(0.00) 0.60 J
3618. 46	3	30	27628. 2	14 _{4½} —423 _{3½}	
				23 _{4½} —508 _{4½}	

TABLE 3.—Classified lines of W II—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
3613. 80	30	80	27663. 9	$14_{1\frac{1}{2}}-422_{1\frac{1}{2}}$	(0.40) 1.40 J; $\frac{3}{2}-\frac{3}{2}$ Be
3592. 43	50	80	27828. 4	$11_{2\frac{1}{2}}-391_{1\frac{1}{2}}$	(0.00) 1.13 J
3572. 48	100	200	27983. 8	$10_{1\frac{1}{2}}-385_{0\frac{1}{2}}$	
3572. 03	8v	10	27987. 5	$23_{2\frac{1}{2}}-514_{2\frac{1}{2}}$	
3563. 98		3	28050. 5	$20_{4\frac{1}{2}}-488_{3\frac{1}{2}}$	
3555. 18	12	120	28120. 0	$16_{2\frac{1}{2}}-443_{2\frac{1}{2}}$	(0.93) 1.31 J
3549. 08	30d?	150	28168. 3	$16_{3\frac{1}{2}}-447_{4\frac{1}{2}}$	(0.00) 1.50 J
3544. 48	3	30	28204. 8	$16_{4\frac{1}{2}}-447_{4\frac{1}{2}}$	
3539. 48	3	15	28244. 7	$20_{3\frac{1}{2}}-482_{2\frac{1}{2}}$	
3534. 14		10	28287. 4	$16_{3\frac{1}{2}}-448_{3\frac{1}{2}}$	
3529. 57	60r?	100	28324. 0	$16_{4\frac{1}{2}}-448_{3\frac{1}{2}}$	(0.00) 0.97 J
3527. 05		40	28344. 2	$20_{4\frac{1}{2}}-491_{3\frac{1}{2}}$	(0.00) 1.04 J
3518. 57	1	3	28412. 5	$23_{2\frac{1}{2}}-518_{3\frac{1}{2}}$	
3503. 24		4	28536. 9	$10_{1\frac{1}{2}}-391_{1\frac{1}{2}}$	
3492. 08	1	40	28628. 1	$23_{4\frac{1}{2}}-518_{3\frac{1}{2}}$	
3490. 92	12	80	28637. 6	$13_{3\frac{1}{2}}-420_{2\frac{1}{2}}$	(0.00) 1.00 J
3490. 33	8	50	28642. 4	$16_{2\frac{1}{2}}-448_{3\frac{1}{2}}$	
3489. 81	1	10	28646. 7	$20_{5\frac{1}{2}}-491_{4\frac{1}{2}}$	
3486. 14	10	100	28676. 8	$16_{2\frac{1}{2}}-449_{1\frac{1}{2}}$	
3472. 33	1	15	28790. 9	$20_{3\frac{1}{2}}-488_{3\frac{1}{2}}$	
3468. 24	6v	10	28824. 8	$23_{2\frac{1}{2}}-522_{3\frac{1}{2}}$	
3463. 52	20v	200	28864. 1	$13_{2\frac{1}{2}}-422_{1\frac{1}{2}}$	(0.00) 1.47 J
3452. 51	6	30	28956. 2	$13_{2\frac{1}{2}}-423_{3\frac{1}{2}}$	
3449. 88	8	80	28978. 2	$13_{3\frac{1}{2}}-423_{3\frac{1}{2}}$	(0.00) 1.28 J
3442. 52	2	20?	29040. 2	$23_{4\frac{1}{2}}-522_{3\frac{1}{2}}$	
3440. 60		20	29056. 4	$17_{5\frac{1}{2}}-464_{4\frac{1}{2}}$	(0.00) 1.00 J
3437. 25		20b?	29084. 7	$20_{3\frac{1}{2}}-491_{3\frac{1}{2}}$	
3430. 57		2	29141. 4	$20_{3\frac{1}{2}}-491_{4\frac{1}{2}}$	
3401. 90	30	150	29386. 9	$14_{2\frac{1}{2}}-443_{2\frac{1}{2}}$	(0.79) 1.25 J
3394. 47	1	20	29451. 3	$23_{2\frac{1}{2}}-529_{3\frac{1}{2}}$	
3379. 04	2	50	29585. 7	$16_{3\frac{1}{2}}-461_{3\frac{1}{2}}$	
3376. 17	20	400	29610. 9	$15_{3\frac{1}{2}}-447_{4\frac{1}{2}}$	(0.00) 2.14 J; $7/2-9/2$ Be
3374. 87	-----	30	29622. 3	$16_{4\frac{1}{2}}-461_{3\frac{1}{2}}$	
3370. 25	-----	5	29662. 9	$23_{2\frac{1}{2}}-531_{2\frac{1}{2}}$	
3369. 81	1b	6bl	29666. 8	$23_{4\frac{1}{2}}-529_{3\frac{1}{2}}$	
3363. 73	15c	40	29720. 4	$14_{1\frac{1}{2}}-443_{2\frac{1}{2}}$	
3362. 60	-----	2p	29730. 4	$15_{3\frac{1}{2}}-448_{3\frac{1}{2}}$	
3361. 11	40	100	29743. 6	$08_{0\frac{1}{2}}-385_{0\frac{1}{2}}$	(0.00) 2.01 J; (0.82) 2.50 Be
3359. 28	-----	30	29759. 8	$19_{4\frac{1}{2}}-488_{3\frac{1}{2}}$	
3358. 62	70	200	29765. 6	$16_{3\frac{1}{2}}-463_{2\frac{1}{2}}$	(0.00) 1.11 J
3352. 38	3c	30b	29821. 0	$14_{1\frac{1}{2}}-444_{0\frac{1}{2}}$	
3347. 47	-----	3b	29864. 8	$4F_{1\frac{1}{2}}-385_{0\frac{1}{2}}$	
3345. 86	200	200b	29879. 1	$23_{2\frac{1}{2}}-533_{1\frac{1}{2}}$	(0.00) .93 J
3344. 89	5	25	29887. 8	$23_{2\frac{1}{2}}-533_{3\frac{1}{2}}$	
3343. 40	12	120	29901. 1	$14_{4\frac{1}{2}}-447_{4\frac{1}{2}}$	(0.00) 1.12 J

TABLE 3.—*Classified lines of W II—Continued*

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
3343. 09	10	100	29903. 9	$16_{3\frac{1}{2}}-464_{4\frac{1}{2}}$	(0.00) 1.41 J
3342. 46	30	300	29909. 5	$14_{2\frac{1}{2}}-448_{3\frac{1}{2}}$	(0.00) 1.70 J
3339. 03	5	60	29940. 2	$16_{4\frac{1}{2}}-464_{4\frac{1}{2}}$	
3338. 63	5	50	29943. 8	$16_{2\frac{1}{2}}-461_{3\frac{1}{2}}$	
3335. 40	-----	5 <i>b</i>	29972. 8	$14_{2\frac{1}{2}}-449_{1\frac{1}{2}}$	
				$23_{2\frac{1}{2}}-534_{1\frac{1}{2}}$	
3320. 94	-----	20 <i>b</i>	30103. 3	$23_{4\frac{1}{2}}-533_{3\frac{1}{2}}$	
3317. 41	2	25 <i>b</i>	30135. 4	$23_{3\frac{1}{2}}-533_{4\frac{1}{2}}$	
3301. 85	18 <i>cv</i>	20	30277. 4	$14_{1\frac{1}{2}}-449_{1\frac{1}{2}}$	
3299. 74	6	30	30296. 7	$08_{0\frac{1}{2}}-391_{1\frac{1}{2}}$	
3286. 57	20	100	30418. 1	$^4F_{1\frac{1}{2}}-391_{1\frac{1}{2}}$	
3257. 81	?	20 <i>b</i>	30686. 6	$23_{2\frac{1}{2}}-541_{1\frac{1}{2}}$	
3254. 85	1 <i>c</i>	10 <i>b</i>	30714. 6	$20_{4\frac{1}{2}}-514_{5\frac{1}{2}}$	
3251. 25	?	50 <i>cl</i>	30748. 6	$11_{2\frac{1}{2}}-420_{2\frac{1}{2}}$	
3243. 48	1	4 <i>b</i>	30822. 2	$23_{4\frac{1}{2}}-540_{4\frac{1}{2}}$	
				$14_{1\frac{1}{2}}-454_{0\frac{1}{2}}$	
3243. 36	20 <i>v</i>	100	30823. 4	$16_{3\frac{1}{2}}-474_{2\frac{1}{2}}$	(0.00) 1.24 J
				$20_{3\frac{1}{2}}-508_{4\frac{1}{2}}$	
3233. 15	3	15 <i>b</i>	30920. 7	$13_{2\frac{1}{2}}-443_{2\frac{1}{2}}$	
3230. 85	15 <i>l</i>	15	30942. 7	$13_{3\frac{1}{2}}-443_{2\frac{1}{2}}$	
3230. 61	5 <i>p</i>	25	30945. 0	$16_{2\frac{1}{2}}-471_{1\frac{1}{2}}$	
3228. 99	8 <i>cl</i>	20 <i>b</i>	30960. 5	$20_{5\frac{1}{2}}-514_{5\frac{1}{2}}$	
3225. 18	1	4 <i>b</i>	30997. 1	$11_{2\frac{1}{2}}-422_{1\frac{1}{2}}$	
3216. 32	2	30	31082. 5	$20_{4\frac{1}{2}}-518_{3\frac{1}{2}}$	
3215. 67	?	30	31088. 8	$11_{2\frac{1}{2}}-423_{3\frac{1}{2}}$	
3206. 42	8?	80	31178. 4	$16_{2\frac{1}{2}}-474_{2\frac{1}{2}}$	
3203. 44	8 <i>v</i>	40	31207. 5	$14_{2\frac{1}{2}}-461_{3\frac{1}{2}}$	
3203. 34	12	80	31208. 4	$15_{3\frac{1}{2}}-463_{2\frac{1}{2}}$	
3192. 11	-----	15 <i>bc</i>	31318. 2	$14_{4\frac{1}{2}}-461_{3\frac{1}{2}}$	
3189. 24	50 <i>a</i>	100 <i>l</i>	31346. 4	$13_{3\frac{1}{2}}-447_{4\frac{1}{2}}$	
				$15_{3\frac{1}{2}}-464_{4\frac{1}{2}}$	
3185. 06	3 <i>d</i>	30	31387. 5	$14_{2\frac{1}{2}}-463_{2\frac{1}{2}}$	
3183. 97	4	10	31398. 3	$20_{3\frac{1}{2}}-514_{2\frac{1}{2}}$	
3179. 44	15	150	31443. 0	$13_{2\frac{1}{2}}-448_{3\frac{1}{2}}$	
3178. 04	8?	80	31456. 9	$10_{1\frac{1}{2}}-420_{2\frac{1}{2}}$	
3177. 22	60 <i>d(r)</i>	150	31465. 0	$13_{3\frac{1}{2}}-448_{3\frac{1}{2}}$	
3175. 97	20	200	31477. 4	$13_{2\frac{1}{2}}-449_{1\frac{1}{2}}$	
3160. 03	20	300	31636. 1	$14_{4\frac{1}{2}}-464_{4\frac{1}{2}}$	(0. 00) 1.38 J
3154. 19	6	15	31694. 7	$16_{3\frac{1}{2}}-482_{2\frac{1}{2}}$	
3153. 14	?	3 <i>b</i>	31705. 3	$10_{1\frac{1}{2}}-422_{1\frac{1}{2}}$	
3152. 76	6 <i>b</i>	10 <i>b</i>	31709. 1	$^6S_{2\frac{1}{2}}-391_{1\frac{1}{2}}$	
3151. 58	6	20	31721. 0	$14_{1\frac{1}{2}}-463_{2\frac{1}{2}}$	
3151. 31	6	300	31723. 7	$23_{4\frac{1}{2}}-549_{5\frac{1}{2}}$	
3149. 87	20	500	31738. 2	$13_{0\frac{1}{2}}-449_{1\frac{1}{2}}$	(0. 00) 1.61 J
3144. 50	-----	30 <i>b</i>	31792. 4	$19_{4\frac{1}{2}}-508_{4\frac{1}{2}}$	
3108. 79	10	80	32157. 6	$23_{4\frac{1}{2}}-553_{4\frac{1}{2}}$	
3103. 53	2 <i>v</i>	20	32212. 1	$14_{2\frac{1}{2}}-471_{1\frac{1}{2}}$	
3101. 23	-----	6	32235. 9	$20_{3\frac{1}{2}}-522_{3\frac{1}{2}}$	
3100. 75	6 <i>v</i>	60	32240. 9	$16_{3\frac{1}{2}}-488_{3\frac{1}{2}}$	

TABLE 3.—Classified lines of W II—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
3098. 31	3	15	32266. 3	$15_{3\frac{3}{2}}-474_{2\frac{3}{2}}$	
3083. 29	?	2	32423. 5	$19_{4\frac{3}{2}}-514_{5\frac{3}{2}}$	
3081. 23	1	4b	32445. 2	$14_{2\frac{3}{2}}-474_{2\frac{3}{2}}$	
3072. 75	6v	40	32534. 7	$16_{3\frac{3}{2}}-491_{3\frac{3}{2}}$	
3071. 74	10	60	32545. 4	$14_{1\frac{3}{2}}-471_{1\frac{3}{2}}$	
3069. 29	10	90	32571. 4	$16_{4\frac{3}{2}}-491_{3\frac{3}{2}}$	
3067. 58	8	80	32589. 6	$20_{4\frac{3}{2}}-533_{4\frac{3}{2}}$	
3067. 42	4	10	32591. 3	$16_{3\frac{3}{2}}-491_{4\frac{3}{2}}$	
3066. 99	8(v?)	80	32595. 8	$16_{2\frac{3}{2}}-488_{3\frac{3}{2}}$	
3063. 98	5	50	32627. 8	$16_{4\frac{3}{2}}-491_{4\frac{3}{2}}$	
3063. 42	?	20b	32633. 8	$23_{2\frac{3}{2}}-560_{1\frac{3}{2}}$	
3061. 69	10	30	32652. 2	$16_{3\frac{3}{2}}-492_{2\frac{3}{2}}$	
3053. 36	10b	?	32741. 3	$13_{2\frac{3}{2}}-461_{3\frac{3}{2}}$	
3051. 30	40	400	32763. 4	$13_{3\frac{3}{2}}-461_{3\frac{3}{2}}$	
3049. 86	8	60	32778. 9	$14_{1\frac{3}{2}}-474_{2\frac{3}{2}}$	
3048. 61	4	40	32792. 3	$19_{4\frac{3}{2}}-518_{3\frac{3}{2}}$	
3044. 57	-----	1b	32835. 8	$20_{5\frac{3}{2}}-533_{4\frac{3}{2}}$	
3039. 59	3v	30	32889. 6	$16_{2\frac{3}{2}}-491_{3\frac{3}{2}}$	
3036. 68	8v	100	32921. 2	$13_{2\frac{3}{2}}-463_{2\frac{3}{2}}$	
3028. 74	-----	15b	33007. 4	$16_{2\frac{3}{2}}-492_{2\frac{3}{2}}$	
3024. 51	30	300	33053. 6	$11_{2\frac{3}{2}}-443_{2\frac{3}{2}}$	
3022. 68	5bv	50	33073. 6	$20_{3\frac{3}{2}}-531_{2\frac{3}{2}}$	
3021. 98	50	100	33081. 3	$13_{3\frac{3}{2}}-464_{4\frac{3}{2}}$	
3010. 76	5	100	33204. 5	$19_{4\frac{3}{2}}-522_{3\frac{3}{2}}$	
3004. 29	7v	5	33276. 1	$20_{4\frac{3}{2}}-540_{4\frac{3}{2}}$	
3002. 29	2	40	33298. 2	$20_{3\frac{3}{2}}-533_{3\frac{3}{2}}$	
3000. 63	5	50	33316. 7	$14_{2\frac{3}{2}}-482_{2\frac{3}{2}}$	
3000. 50	-----	3b	33318. 1	$23_{2\frac{3}{2}}-567_{2\frac{3}{2}}$	
2998. 69	15	50	33338. 2	$^4F_{1\frac{1}{2}}-420_{2\frac{3}{2}}$	(0.00) 1.98 J
2990. 85	-----	12b	33425. 6	$17_{5\frac{3}{2}}-508_{4\frac{3}{2}}$	
2987. 29	15	60	33465. 4	$08_{0\frac{3}{2}}-422_{1\frac{3}{2}}$	(0.46) 0.00b, 1.09 , 2.04
2982. 22	2	25	33522. 3	$20_{5\frac{3}{2}}-540_{4\frac{3}{2}}$	
2977. 44	-----	3b	33576. 1	$11_{2\frac{3}{2}}-448_{3\frac{3}{2}}$	
2976. 48	15	50	33587. 0	$^4F_{1\frac{1}{2}}-422_{1\frac{3}{2}}$	(1.28) 0.00, 1.05 , 1.95
2974. 38	20	35	33610. 7	$11_{2\frac{3}{2}}-449_{1\frac{3}{2}}$	(0.00) 0.94
2970. 91	2	5	33649. 9	$14_{1\frac{3}{2}}-482_{2\frac{3}{2}}$	
2967. 92	4	20	33683. 8	$15_{3\frac{3}{2}}-488_{3\frac{3}{2}}$	
2962. 51	-----	8b	33745. 3	$13_{2\frac{3}{2}}-471_{1\frac{3}{2}}$	
2961. 02	12	50	33762. 3	$10_{1\frac{3}{2}}-443_{2\frac{3}{2}}$	
2955. 01	8	15	33831. 0	$19_{4\frac{3}{2}}-529_{3\frac{3}{2}}$	
2952. 26	75d?	100d?	33862. 5	$\{14_{2\frac{3}{2}}-488_{3\frac{3}{2}}$ $\{10_{1\frac{3}{2}}-444_{0\frac{3}{2}}$	
2942. 62	3	10	33973. 4	$14_{4\frac{3}{2}}-488_{3\frac{3}{2}}$	
2942. 26	2	10	33977. 6	$15_{3\frac{3}{2}}-491_{3\frac{3}{2}}$	
2942. 13	12	10d	33979. 1	$13_{2\frac{3}{2}}-474_{2\frac{3}{2}}$	
2940. 21	8	60	34001. 3	$13_{3\frac{3}{2}}-474_{2\frac{3}{2}}$	(0.00)

TABLE 3.—*Classified lines of W II—Continued*

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
2939. 76	6	35	34006. 5	$13_{0\frac{1}{2}}-471_{1\frac{1}{2}}$	(0.27)
2938. 87	2	12 <i>b</i>	34016. 8	$20_{3\frac{1}{2}}-540_{4\frac{1}{2}}$	
2935. 36	8	25	34057. 4	$17_{5\frac{1}{2}}-514_{3\frac{1}{2}}$	(0.80)
2926. 84	3	15	34156. 6	$14_{2\frac{1}{2}}-491_{3\frac{1}{2}}$	
2925. 00	4	40	34178. 1	$20_{1\frac{1}{2}}-549_{3\frac{1}{2}}$	(0.00 1.20)
2917. 39	3	5	34267. 2	$\{14_{4\frac{1}{2}}-491_{3\frac{1}{2}}\}$	
2916. 90	2	12 <i>b</i>	34273. 0	$19_{1\frac{1}{2}}-533_{3\frac{1}{2}}$	
2916. 77	3	10	34274. 5	$16_{3\frac{1}{2}}-508_{4\frac{1}{2}}$	
2916. 35	7 <i>l</i>	5 <i>b</i>	34279. 4	$14_{2\frac{1}{2}}-492_{2\frac{1}{2}}$	
2914. 65	2	15	34299. 4	$23_{2\frac{1}{2}}-577_{3\frac{1}{2}}$	
				$19_{4\frac{1}{2}}-533_{4\frac{1}{2}}$	
2913. 75	12	30	34310. 0	$16_{4\frac{1}{2}}-508_{4\frac{1}{2}}$	
2912. 58	3	5	34323. 8	$14_{4\frac{1}{2}}-491_{4\frac{1}{2}}$	
2904. 08	8	80	34424. 2	$20_{5\frac{1}{2}}-549_{5\frac{1}{2}}$	(0.40) 1.22
2898. 10	-----	2	34495. 3	$23_{4\frac{1}{2}}-577_{3\frac{1}{2}}$	
2888. 70	-----	4 <i>b</i>	34607. 5	$14_{1\frac{1}{2}}-492_{2\frac{1}{2}}$	
2888. 32	15	8 <i>b</i>	34612. 1	$20_{1\frac{1}{2}}-553_{4\frac{1}{2}}$	
2886. 92	5 <i>cv</i>	35	34628. 8	$^6\text{S}_{2\frac{1}{2}}-420_{2\frac{1}{2}}$	
2885. 46	1	2 <i>b</i>	34646. 4	$^6\text{D}_{1\frac{1}{2}}-361_{0\frac{1}{2}}$	
2883. 92	-----	2 <i>b</i>	34664. 9	$20_{3\frac{1}{2}}-547_{3\frac{1}{2}}$	
2868. 74	8	80	34848. 3	$16_{3\frac{1}{2}}-514_{2\frac{1}{2}}$	
2867. 93	4	20	34858. 1	$20_{5\frac{1}{2}}-553_{4\frac{1}{2}}$	
2867. 41	6	15	34864. 5	$10_{1\frac{1}{2}}-454_{0\frac{1}{2}}$	
2866. 75	6	20	34872. 5	$13_{3\frac{1}{2}}-482_{2\frac{1}{2}}$	
2866. 60	4	8	34874. 3	$11_{2\frac{1}{2}}-461_{1\frac{1}{2}}$	
2866. 32	8	10	34877. 7	$^6\text{S}_{2\frac{1}{2}}-422_{1\frac{1}{2}}$	
2861. 06	2	6	34941. 9	$16_{4\frac{1}{2}}-514_{5\frac{1}{2}}$	
2857. 47	-----	1 <i>b</i> ?	34985. 7	$19_{4\frac{1}{2}}-540_{4\frac{1}{2}}$	
2839. 82	3	10	35203. 2	$16_{2\frac{1}{2}}-514_{2\frac{1}{2}}$	
2834. 21	-----	50 <i>b</i>	35272. 9	$16_{3\frac{1}{2}}-518_{3\frac{1}{2}}$	(<i>d</i> ?)
2831. 24	7	35	35309. 9	$16_{4\frac{1}{2}}-518_{3\frac{1}{2}}$	
2824. 31	4	4 <i>b</i>	35396. 5	$13_{2\frac{1}{2}}-488_{3\frac{1}{2}}$	
2822. 54	25	125	35418. 7	$13_{3\frac{1}{2}}-488_{3\frac{1}{2}}$	(0.56) 1.04 <i>b</i>
2806. 39	3	4 <i>b</i>	35622. 5	$08_{0\frac{1}{2}}-444_{0\frac{1}{2}}$	
2805. 94	20	120	35628. 2	$16_{2\frac{1}{2}}-518_{3\frac{1}{2}}$	
2803. 68	-----	3 <i>b</i>	35656. 9	$23_{4\frac{1}{2}}-588_{5\frac{1}{2}}$	
2801. 43	6 <i>bv</i>	10 <i>b</i>	35685. 6	$16_{3\frac{1}{2}}-522_{3\frac{1}{2}}$	
2801. 06	4	30	35690. 3	$13_{2\frac{1}{2}}-491_{3\frac{1}{2}}$	
2799. 04	20	100	35716. 0	$15_{3\frac{1}{2}}-508_{1\frac{1}{2}}$	(0.00 <i>b</i>)—2.21 <i>a</i> ₂
2796. 87	3	6 <i>b</i>	35743. 8	$^4\text{F}_{1\frac{1}{2}}-444_{0\frac{1}{2}}$	
2791. 85	?	1	35808. 0	$13_{2\frac{1}{2}}-492_{2\frac{1}{2}}$	
2790. 43	5 <i>c</i>	50	35826. 2	$23_{3\frac{1}{2}}-592_{3\frac{1}{2}}$	
2786. 32	7 <i>d</i>	20 <i>b</i>	35879. 1	$11_{2\frac{1}{2}}-471_{1\frac{1}{2}}$	(0.00) 1.18
2785. 64	12 <i>c</i>	50	35887. 8	$19_{4\frac{1}{2}}-549_{3\frac{1}{2}}$	
2782. 14	20	80	35933. 0	$17_{5\frac{1}{2}}-533_{3\frac{1}{2}}$	
2780. 28	60 <i>a</i>	40	35957. 0	$^6\text{D}_{2\frac{1}{2}}-391_{1\frac{1}{2}}$	(0.26, 0.75) 1.38, 1.90, 2.38

TABLE 3.—Classified lines of W II—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
2776.51	20	100	36005.8	$14_{4\frac{1}{2}}-508_{4\frac{1}{2}}$	(0.16?) 1.22
2773.85	5	25	36040.4	$16_{2\frac{1}{2}}-522_{3\frac{1}{2}}$	
2768.32	30	50	36112.3	$11_{2\frac{1}{2}}-474_{3\frac{1}{2}}$	(0) 1.12
2764.26	200	400	36165.4	$^6D_{0\frac{1}{2}}-361_{0\frac{1}{2}}$	(1.27) 1.93
2761.59	40	100b	36200.4	$^4F_{1\frac{1}{2}}-449_{1\frac{1}{2}}$	(0.88) 0.35, 0.94 , 1.48
2758.33	18	20	36243.1	$^6D_{4\frac{1}{2}}-423_{3\frac{1}{2}}$	
2754.70	1	2b	36290.9	$15_{3\frac{1}{2}}-514_{2\frac{1}{2}}$	
2753.10	-----	6b	36312.0	$16_{3\frac{1}{2}}-529_{3\frac{1}{2}}$	
2752.36	1?	2b	36321.7	$19_{4\frac{1}{2}}-553_{4\frac{1}{2}}$	
2750.33	10	20	36348.6	$16_{4\frac{1}{2}}-529_{3\frac{1}{2}}$	
2745.04	2	30b	36418.6	$23_{2\frac{1}{2}}-598_{3\frac{1}{2}}$	
2737.13	1	3b	36523.8	$16_{3\frac{1}{2}}-531_{2\frac{1}{2}}$	
2732.38	4	4b	36587.3	$10_{1\frac{1}{2}}-471_{1\frac{1}{2}}$	
2729.62	25	75	36624.3	$08_{0\frac{1}{2}}-454_{0\frac{1}{2}}$	(0.91) 1.43
2728.88	1	6b	36634.2	$23_{4\frac{1}{2}}-598_{3\frac{1}{2}}$	
2726.44	3	4	36667.0	$16_{2\frac{1}{2}}-529_{3\frac{1}{2}}$	
2722.80	20	70	36716.0	$15_{3\frac{1}{2}}-518_{3\frac{1}{2}}$	
2721.85	4	15	36728.8	$20_{3\frac{1}{2}}-567_{2\frac{1}{2}}$	
2720.60	25dl	40	36745.7	$^4F_{1\frac{1}{2}}-454_{0\frac{1}{2}}$	(0.00) 0.89b
2720.40	6	30	36748.4	$16_{3\frac{1}{2}}-533_{3\frac{1}{2}}$	(0.58)
2718.04	30	120	36780.3	$16_{3\frac{1}{2}}-533_{4\frac{1}{2}}$	(0.00) 0.97
2717.70	3	18b	36784.9	$16_{4\frac{1}{2}}-533_{3\frac{1}{2}}$	
2716.32	30	80	36803.6	$14_{1\frac{1}{2}}-514_{2\frac{1}{2}}$	(0.00) 1.43
2715.35	25	80	36816.8	$16_{4\frac{1}{2}}-533_{4\frac{1}{2}}$	(0.19) 1.12
2714.02	-----	1b	36834.8	$20_{3\frac{1}{2}}-568_{2\frac{1}{2}}$	
2710.79	8	40	36878.7	$16_{2\frac{1}{2}}-531_{2\frac{1}{2}}$	(0.58)
2709.58	20	80	36895.2	$14_{2\frac{1}{2}}-518_{3\frac{1}{2}}$	(0.00) 0.83
2706.73	6pv	50b	36934.0	$^8S_{2\frac{1}{2}}-443_{2\frac{1}{2}}$	
2705.60	10bv	35b	36949.4	$20_{4\frac{1}{2}}-577_{3\frac{1}{2}}$	
2703.12	8	10?	36983.3	$11_{2\frac{1}{2}}-482_{2\frac{1}{2}}$	
2703.06	8	60	36984.1	$23_{4\frac{1}{2}}-602_{0\frac{1}{2}}$	(0.00) 1.38
2701.49	20	60	37005.6	$14_{4\frac{1}{2}}-518_{3\frac{1}{2}}$	(0.00) 2.08a ₂
2697.72	80	160	37057.4	$^6D_{1\frac{1}{2}}-385_{0\frac{1}{2}}$	(b) 1.94
2695.00	6	30	37094.8	$16_{2\frac{1}{2}}-533_{1\frac{1}{2}}$	
2694.38	20	60	37103.3	$16_{2\frac{1}{2}}-533_{3\frac{1}{2}}$	
2688.23	7	35	37188.2	$16_{2\frac{1}{2}}-534_{1\frac{1}{2}}$	(0.00)
2679.64	20	70b	37307.4	$14_{2\frac{1}{2}}-522_{3\frac{1}{2}}$	
2677.79	20	60	37333.1	$^6D_{3\frac{1}{2}}-420_{2\frac{1}{2}}$	
2669.37	5p	30	37450.9	$13_{3\frac{1}{2}}-508_{4\frac{1}{2}}$	(0.00)
2668.96	5	5b	37456.7	$^8S_{2\frac{1}{2}}-448_{3\frac{1}{2}}$	
2668.24	1	5b	37466.8	$16_{3\frac{1}{2}}-540_{0\frac{1}{2}}$	
2666.49	20d?	60	37491.3	$^6S_{2\frac{1}{2}}-449_{1\frac{1}{2}}$	
2665.64	2b	8b	37503.3	$16_{4\frac{1}{2}}-540_{0\frac{1}{2}}$	
2664.35	80cva	200	37521.5	$17_{5\frac{1}{2}}-549_{2\frac{1}{2}}$	(0.41) 1.17 β
2658.04	25	100	37610.6	$^6D_{1\frac{1}{2}}-391_{1\frac{1}{2}}$	(0.40, 1.08) 0.79, 1.49 , 2.22

TABLE 3.—Classified lines of W II—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
2655. 67	15	22	37644. 1	$^4\text{F}_{1\frac{1}{2}}-463_{2\frac{1}{2}}$	(0.12?, 0.57?, 1.00, 1.50)
2653. 57	20	35	37673. 9	$^6\text{D}_{3\frac{1}{2}}-423_{3\frac{1}{2}}$	
2652. 43	-----	4b	37690. 1	$20_{3\frac{1}{2}}-577_{3\frac{1}{2}}$	
2652. 30	1	3b	37691. 9	$10_{1\frac{1}{2}}-482_{2\frac{1}{2}}$	
2650. 28	3	7b	37720. 6	$14_{1\frac{1}{2}}-523_{0\frac{1}{2}}$	
2647. 90	1p	2b	37754. 6	$15_{3\frac{1}{2}}-529_{3\frac{1}{2}}$	
2643. 09	?	10	37823. 3	$11_{2\frac{1}{2}}-491_{3\frac{1}{2}}$	
2637. 58	15	25	37902. 3	$16_{2\frac{1}{2}}-541_{1\frac{1}{2}}$	
2635. 38	6	30	37933. 9	$14_{2\frac{1}{2}}-529_{3\frac{1}{2}}$	
2634. 87	20	9	37941. 3	$11_{2\frac{1}{2}}-492_{2\frac{1}{2}}$	
2633. 89	4	25b	37955. 4	$17_{5\frac{1}{2}}-553_{4\frac{1}{2}}$	(0.00)
2630. 53	6p	9	38003. 8	$13_{2\frac{1}{2}}-514_{2\frac{1}{2}}$	
2630. 38	3p	20	38006. 0	$23_{4\frac{1}{2}}-612_{3\frac{1}{2}}$	
2629. 00	7	35	38026. 0	$13_{3\frac{1}{2}}-514_{2\frac{1}{2}}$	(—) 0.94
2627. 72	4	10	38044. 5	$14_{4\frac{1}{2}}-529_{3\frac{1}{2}}$	
2623. 11	6p	50	38111. 3	$20_{4\frac{1}{2}}-588_{5\frac{1}{2}}$	(0.00) 1.32
2622. 87	1p	2b	38114. 8	$16_{3\frac{1}{2}}-547_{2\frac{1}{2}}$	
2620. 76	7p	30	38145. 5	$14_{2\frac{1}{2}}-531_{2\frac{1}{2}}$	(0.55)
2617. 64	5l	5b	38191. 0	$15_{3\frac{1}{2}}-533_{3\frac{1}{2}}$	
2615. 45	20	80	38223. 0	$15_{3\frac{1}{2}}-533_{4\frac{1}{2}}$	(0.00) 1.72 _{a2}
2606. 97	4	12	38347. 3	$08_{0\frac{1}{2}}-471_{1\frac{1}{2}}$	
2606. 47	4	40	38354. 6	$23_{4\frac{1}{2}}-615_{3\frac{1}{2}}$	
2606. 27	2	20b	38357. 6	$20_{5\frac{1}{2}}-588_{5\frac{1}{2}}$	
2605. 97	7	15	38362. 0	$14_{2\frac{1}{2}}-533_{1\frac{1}{2}}$	
2605. 41	?	5b	38370. 2	$14_{2\frac{1}{2}}-533_{3\frac{1}{2}}$	
2603. 02	20p	120	38405. 5	$16_{4\frac{1}{2}}-549_{5\frac{1}{2}}$	(0.00) 1.03
2601. 43	8	30	38428. 9	$13_{2\frac{1}{2}}-518_{3\frac{1}{2}}$	
2599. 65	3	7	38455. 2	$14_{2\frac{1}{2}}-534_{1\frac{1}{2}}$	
2598. 75	20	35	38468. 6	$^4\text{F}_{1\frac{1}{2}}-471_{1\frac{1}{2}}$	(0.56) 0.42, 0.87 , 1.25.
2598. 67	7?	7?	38469. 7	$16_{2\frac{1}{2}}-547_{2\frac{1}{2}}$	
2596. 87	3	15	38496. 4	$20_{4\frac{1}{2}}-592_{3\frac{1}{2}}$	(0.00) 1.08.
2595. 76	3	8	38512. 8	$14_{4\frac{1}{2}}-533_{4\frac{1}{2}}$	
2591. 49	14	12	38576. 3	$^6\text{D}_{0\frac{1}{2}}-385_{0\frac{1}{2}}$	
2589. 17	16	90	38610. 9	$^6\text{D}_{4\frac{1}{2}}-447_{4\frac{1}{2}}$	(1.13 _{a2}) 1.46 β .
2586. 58	1	5	38649. 5	$10_{1\frac{1}{2}}-492_{2\frac{1}{2}}$	
2585. 93	6	30	38659. 2	$19_{4\frac{1}{2}}-577_{3\frac{1}{2}}$	
2583. 52	3p	5	38695. 3	$14_{1\frac{1}{2}}-533_{1\frac{1}{2}}$	
2581. 20	18	30	38730. 1	$^6\text{D}_{4\frac{1}{2}}-448_{3\frac{1}{2}}$	
2579. 56	20v	100d	38754. 7	$^6\text{S}_{2\frac{1}{2}}-461_{3\frac{1}{2}}$	
2577. 31	-----	5b	38788. 6	$14_{1\frac{1}{2}}-534_{1\frac{1}{2}}$	
2576. 37	8	40	38802. 7	$16_{3\frac{1}{2}}-553_{4\frac{1}{2}}$	
2573. 95	25	7	38839. 2	$16_{4\frac{1}{2}}-553_{4\frac{1}{2}}$	
2573. 82	3	12b	38841. 1	$13_{2\frac{1}{2}}-522_{3\frac{1}{2}}$	(0.00).
2572. 36	8	30	38863. 2	$13_{3\frac{1}{2}}-522_{3\frac{1}{2}}$	(0.34).
2572. 24	8	45	38865. 0	$20_{5\frac{1}{2}}-593_{4\frac{1}{2}}$	(0.00) 1.23.

TABLE 3.—Classified lines of W II—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
2571.46	40	150	38876.8	$^6D_{2\frac{1}{2}}-420_{2\frac{1}{2}}$	(0.84) 0.72, 1.13, 1.50 , 1.86 , 2.25.
2569.30	8	80	38909.5	$15_{3\frac{1}{2}}-540_{4\frac{1}{2}}$	(0.00) 0.73) 1.70 α_2 . (1.67) 1.33.
2567.62	10	30	38934.9	$^6S_{2\frac{1}{2}}-463_{2\frac{1}{2}}$	
2557.51	-----	2	39088.8	$20_{4\frac{1}{2}}-598_{3\frac{1}{2}}$	(0.00) 1.82.
2555.10	20	100	39125.7	$^6D_{2\frac{1}{2}}-422_{1\frac{1}{2}}$	
2554.86	20?	60	39129.3	$^6D_{0\frac{1}{2}}-391_{1\frac{1}{2}}$	(1.04).
2552.25	5	5	39169.4	$14_{2\frac{1}{2}}-541_{1\frac{1}{2}}$	
2551.45	-----	15 <i>b</i>	39181.6	$13_{0\frac{1}{2}}-523_{0\frac{1}{2}}$	(0.00) 1.32. (0.00) 1.16. (0.68).
2550.29	5 <i>p</i>	8 <i>b</i>	39199.5	$14_{4\frac{1}{2}}-540_{4\frac{1}{2}}$	
2549.10	5	15	39217.8	$^6D_{2\frac{1}{2}}-423_{3\frac{1}{2}}$	(0.00) 1.32. (0.00) 1.16. (0.68).
2547.84	-----	5 <i>b</i>	39237.2	$20_{3\frac{1}{2}}-592_{3\frac{1}{2}}$	
2539.92	3	20 <i>b</i>	39359.5	$20_{3\frac{1}{2}}-593_{4\frac{1}{2}}$	(0.00).
2534.83	8	50	39438.5	$20_{4\frac{1}{2}}-602_{5\frac{1}{2}}$	
2532.96	6	15	39467.6	$13_{2\frac{1}{2}}-529_{3\frac{1}{2}}$	(0.45).
2530.70	10	8	39502.9	$14_{1\frac{1}{2}}-541_{1\frac{1}{2}}$	
2527.20	2	15	39557.6	$15_{3\frac{1}{2}}-547_{2\frac{1}{2}}$	(0.00).
2526.21	4	10	39573.1	$^4F_{1\frac{1}{2}}-482_{2\frac{1}{2}}$	
2522.04	40	80	39638.5	$^6D_{3\frac{1}{2}}-443_{2\frac{1}{2}}$	(0.65).
2519.44	8	30	39679.4	$13_{2\frac{1}{2}}-531_{2\frac{1}{2}}$	
2519.12	4	7	39684.5	$20_{5\frac{1}{2}}-602_{5\frac{1}{2}}$	(0.45).
2515.81	2 <i>p</i>	10	39736.7	$14_{2\frac{1}{2}}-547_{2\frac{1}{2}}$	
2514.36	2	4 <i>b</i>	39759.6	$^6S_{2\frac{1}{2}}-471_{1\frac{1}{2}}$	(0.00) 0.00 <i>b</i> , 1.19 .
2510.48	15	75	39821.0	$19_{4\frac{1}{2}}-588_{5\frac{1}{2}}$	
2509.95	6	40	39829.4	$20_{3\frac{1}{2}}-598_{3\frac{1}{2}}$	(1.23, 2.03) 0.00, 0.71, 1.54 , 2.33
2508.69	?	4	39849.4	$16_{2\frac{1}{2}}-560_{1\frac{1}{2}}$	
2505.79	3 <i>p</i>	5	39895.6	$13_{2\frac{1}{2}}-533_{1\frac{1}{2}}$	(0.93 α_2) 0.58. . . 2.03
2505.27		1 <i>b</i>	39903.8	$13_{2\frac{1}{2}}-533_{3\frac{1}{2}}$	
2501.88	30 <i>l</i>	10	39957.9	$13_{3\frac{1}{2}}-533_{4\frac{1}{2}}$	(0.28)
2499.93	3	4	39989.1	$13_{2\frac{1}{2}}-534_{1\frac{1}{2}}$	
2499.69	30 <i>v</i>	100	39992.9	$^6S_{2\frac{1}{2}}-474_{2\frac{1}{2}}$	(0.50)
2497.48	35	75	40028.3	$^6D_{4\frac{1}{2}}-461_{3\frac{1}{2}}$	
2496.65	50	120 <i>l</i>	40041.6	$^6D_{3\frac{1}{2}}-447_{4\frac{1}{2}}$	(0.50)
2494.87	?	7	40070.2	$14_{1\frac{1}{2}}-547_{2\frac{1}{2}}$	
2492.93	18	75	40101.4	$14_{4\frac{1}{2}}-549_{5\frac{1}{2}}$	(0.28)
2490.72	12	25	40136.9	$11_{2\frac{1}{2}}-514_{2\frac{1}{2}}$	
2489.51	5	12	40156.4	$13_{0\frac{1}{2}}-533_{1\frac{1}{2}}$	(0.88 α_2) 1.39 β
2489.23	40 <i>pr</i>	200	40160.9	$^6D_{3\frac{1}{2}}-448_{3\frac{1}{2}}$	
2488.12	8 <i>p</i>	30	40178.9	$16_{3\frac{1}{2}}-567_{2\frac{1}{2}}$	(0.28)
2486.43	6 <i>p</i>	18	40206.2	$19_{4\frac{1}{2}}-592_{3\frac{1}{2}}$	
2484.01	7	20	40245.3	$15_{3\frac{1}{2}}-553_{4\frac{1}{2}}$	(0.28)
2483.74	5	7	40249.7	$13_{0\frac{1}{2}}-534_{1\frac{1}{2}}$	
2481.54	10	30	40285.4	$16_{3\frac{1}{2}}-568_{2\frac{1}{2}}$	(0.88 α_2) 1.39 β
2478.88	4 <i>p</i>	10	40328.6	$19_{4\frac{1}{2}}-593_{4\frac{1}{2}}$	
2477.80	25	200	40346.2	$^6D_{4\frac{1}{2}}-464_{4\frac{1}{2}}$	(0.88 α_2) 1.39 β
2470.81	8	70	40460.3	$20_{4\frac{1}{2}}-612_{5\frac{1}{2}}$	

TABLE 3.—Classified lines of W II—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
2466. 52	35	80	40530. 7	$^6D_{1\frac{1}{2}}-420_{2\frac{1}{2}}$	(0.26 , 0.81) 0.45 , 0.99, 1.56
2466. 33	5 <i>p</i>	10	40533. 8	$16_{2\frac{1}{2}}-567_{2\frac{1}{2}}$	(0.00) 0.73
2464. 62	14	40	40561. 9	$11_{2\frac{1}{2}}-518_{2\frac{1}{2}}$	
2459. 88	4 <i>p</i>	30	40640. 1	$16_{2\frac{1}{2}}-568_{2\frac{1}{2}}$	
2459. 60	20	10	40644. 7	$13_{2\frac{1}{2}}-540_{2\frac{1}{2}}$	
2456. 07	4 <i>p</i>	8	40703. 1	$13_{2\frac{1}{2}}-541_{1\frac{1}{2}}$	(0.49 α_2) 1.49 β
2455. 87	6	35	40706. 5	$20_{2\frac{1}{2}}-612_{2\frac{1}{2}}$	
2451. 47	35 <i>rl</i>	50 <i>d?</i>	40779. 5	$^6D_{1\frac{1}{2}}-422_{1\frac{1}{2}}$	
2450. 32	2	7	40798. 6	$19_{1\frac{1}{2}}-598_{2\frac{1}{2}}$	
2449. 70	4	20	40809. 0	$20_{1\frac{1}{2}}-615_{2\frac{1}{2}}$	
2447. 52		1	40845. 3	$10_{1\frac{1}{2}}-514_{2\frac{1}{2}}$	(0.80, 1.40) 0.54, 1.10, 1.66 , 2.22, 2.78
2446. 39	25 <i>v</i>	120	40864. 2	$^6S_{2\frac{1}{2}}-482_{2\frac{1}{2}}$	
2440. 43	10	20	40964. 0	$12_{0\frac{1}{2}}-541_{1\frac{1}{2}}$	
2439. 81	2	7	40974. 4	$11_{2\frac{1}{2}}-522_{2\frac{1}{2}}$	
2435. 01	10	50	41055. 1	$20_{2\frac{1}{2}}-615_{2\frac{1}{2}}$	(0.57)
2431. 37	5	18	41116. 6	$14_{2\frac{1}{2}}-560_{1\frac{1}{2}}$	(0.58) 1.55
2429. 97	1	6	41140. 3	$16_{2\frac{1}{2}}-577_{2\frac{1}{2}}$	
2429. 53	3	8	41147. 7	$19_{1\frac{1}{2}}-602_{2\frac{1}{2}}$	
2427. 81	4	6	41176. 9	$16_{1\frac{1}{2}}-577_{2\frac{1}{2}}$	
2427. 49	10	40	41182. 3	$^6D_{2\frac{1}{2}}-443_{2\frac{1}{2}}$	
2422. 29	30	20	41270. 7	$13_{2\frac{1}{2}}-547_{2\frac{1}{2}}$	
2420. 99	12	35	41292. 9	$13_{2\frac{1}{2}}-547_{2\frac{1}{2}}$	(0.00) 1.35} not re- (0.31) 1.27} solved.
2414. 13	4 <i>v</i>	7	41410. 2	$^6S_{2\frac{1}{2}}-488_{2\frac{1}{2}}$	
2411. 82	10	25	41449. 9	$14_{1\frac{1}{2}}-560_{1\frac{1}{2}}$	
2411. 54	6	20	41454. 7	$17_{2\frac{1}{2}}-588_{2\frac{1}{2}}$	
2411. 29	7	3	41459. 0	$^6D_{3\frac{1}{2}}-461_{2\frac{1}{2}}$	(0.00) 0.90
2403. 07	5	10	41600. 8	$11_{2\frac{1}{2}}-529_{2\frac{1}{2}}$	
2401. 86	5	12	41621. 7	$15_{2\frac{1}{2}}-567_{2\frac{1}{2}}$	
2400. 86	4	2	41639. 0	$^6D_{2\frac{1}{2}}-463_{2\frac{1}{2}}$	
2397. 10	20 <i>r</i>	200	41704. 4	$^6D_{2\frac{1}{2}}-448_{2\frac{1}{2}}$	
2395. 73	5	8 <i>l</i>	41728. 2	$15_{2\frac{1}{2}}-568_{2\frac{1}{2}}$	
2395. 10	9	10	41739. 2	$^6D_{2\frac{1}{2}}-449_{1\frac{1}{2}}$	
2393. 77	1	3	41762. 4	$10_{1\frac{1}{2}}-523_{0\frac{1}{2}}$	(0.00, 0.61?, 0.89?) 0.55 , 1.03?
2392. 93	20	60	41777. 0	$^6D_{2\frac{1}{2}}-464_{2\frac{1}{2}}$	
2391. 59	2 <i>v</i>	3	41800. 4	$14_{2\frac{1}{2}}-567_{2\frac{1}{2}}$	
2390. 89	4	30	41812. 7	$11_{2\frac{1}{2}}-531_{2\frac{1}{2}}$	(0.00) 1.11
2390. 37	25	75	41821. 8	$^8S_{2\frac{1}{2}}-492_{2\frac{1}{2}}$	(0.50?, 0.97) 1.72 β
2385. 50	8	12	41907. 1	$14_{2\frac{1}{2}}-568_{2\frac{1}{2}}$	(0.00)
2382. 36	7	20	41962. 4	$17_{2\frac{1}{2}}-593_{2\frac{1}{2}}$	
2381. 33	6	8	41980. 5	$13_{2\frac{1}{2}}-553_{2\frac{1}{2}}$	
2378. 60	10	15	42028. 7	$11_{2\frac{1}{2}}-533_{1\frac{1}{2}}$	(0.00)
2378. 13	8	15	42037. 0	$11_{2\frac{1}{2}}-533_{2\frac{1}{2}}$	
2373. 31	-----	1	42122. 4	$11_{2\frac{1}{2}}-534_{1\frac{1}{2}}$	
2370. 62	5	12	42170. 2	$19_{2\frac{1}{2}}-612_{2\frac{1}{2}}$	(0.00)
2366. 68	4 <i>l</i>	6	42240. 4	$14_{1\frac{1}{2}}-568_{2\frac{1}{2}}$	

TABLE 3.—Classified lines of W II—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
2363.46	8	14	42297.8	$^6D_{0\frac{1}{2}}-422_{1\frac{1}{2}}$	(0.00) 1.24
2361.19	12	10	42338.6	$16_{4\frac{1}{2}}-588_{3\frac{1}{2}}$	
2351.17	1	1b	42519.0	$19_{4\frac{1}{2}}-615_{3\frac{1}{2}}$	
2351.05	2	6	42521.2	$10_{1\frac{1}{2}}-531_{2\frac{1}{2}}$	
2347.64	1	3b	42582.8	$15_{3\frac{1}{2}}-577_{3\frac{1}{2}}$	
2341.90	1	6	42687.3	$16_{3\frac{1}{2}}-592_{3\frac{1}{2}}$	(0.22, 0.68 , 1.15) 0.42?, 2.07, 2.51 (0.00) 1.25
2341.37	25	35	42696.9	$^6D_{3\frac{1}{2}}-474_{2\frac{1}{2}}$	
2339.90	6	20	42723.8	$16_{4\frac{1}{2}}-592_{3\frac{1}{2}}$	
2339.73	10	8	42726.9	$^4F_{1\frac{1}{2}}-514_{2\frac{1}{2}}$	
2339.16	15	30	42737.3	$10_{1\frac{1}{2}}-533_{1\frac{1}{2}}$	
2337.80	6	20	42762.1	$14_{2\frac{1}{2}}-577_{3\frac{1}{2}}$	(0.25, 0.75) 0.71 , 1.31
2336.71	6	15	42781.9	$17_{5\frac{1}{2}}-602_{3\frac{1}{2}}$	
2335.21	6	25	42809.6	$16_{3\frac{1}{2}}-593_{3\frac{1}{2}}$	
2334.07	5	5	42830.5	$10_{1\frac{1}{2}}-534_{1\frac{1}{2}}$	
2333.77	15	35	42836.0	$^6D_{1\frac{1}{2}}-443_{2\frac{1}{2}}$	
2331.78	3	4	42872.5	$14_{4\frac{1}{2}}-577_{3\frac{1}{2}}$	(0.34) 0.61, 1.86 (1.05) 2.91 (0.00) 1.62
2329.69	6	15	42911.0	$13_{0\frac{1}{2}}-560_{1\frac{1}{2}}$	
2328.32	20	35	42936.2	$^6D_{1\frac{1}{2}}-444_{0\frac{1}{2}}$	
2326.09	15r?	60	42977.4	$^6D_{4\frac{1}{2}}-491_{1\frac{1}{2}}$	
2324.71	1	1	43002.8	$^6D_{2\frac{1}{2}}-461_{3\frac{1}{2}}$	
2323.04	15	25	43033.8	$^6D_{4\frac{1}{2}}-491_{1\frac{1}{2}}$	(0.38) 1.14 (0.5 61/05) 0.81, 1.40 , 2.04
2322.59	2	3b	43042.2	$16_{2\frac{1}{2}}-592_{3\frac{1}{2}}$	
2315.02	20	50	43182.9	$^6D_{2\frac{1}{2}}-463_{3\frac{1}{2}}$	
2309.85	8	25	43279.5	$16_{3\frac{1}{2}}-598_{3\frac{1}{2}}$	
2307.93	5	10	43315.5	$16_{4\frac{1}{2}}-598_{3\frac{1}{2}}$	
2306.92	15	40	43334.5	$13_{2\frac{1}{2}}-567_{2\frac{1}{2}}$	(0.34, 0.99) 1.01, 1.57 , 2.24
2303.82	25	75	43392.8	$^6D_{1\frac{1}{2}}-449_{1\frac{1}{2}}$	
2301.28	3	5	43440.7	$13_{2\frac{1}{2}}-568_{2\frac{1}{2}}$	
2300.08	1	5	43463.3	$13_{3\frac{1}{2}}-568_{3\frac{1}{2}}$	
2296.96	8	6	43522.4	$08_{0\frac{1}{2}}-523_{0\frac{1}{2}}$	
2295.78	15	20	43544.7	$10_{1\frac{1}{2}}-541_{1\frac{1}{2}}$	(0.35) 1.16
2294.55	10?	35	43568.1	$^6D_{3\frac{1}{2}}-482_{3\frac{1}{2}}$	
2290.56	15	20	43644.0	$^4F_{1\frac{1}{2}}-523_{0\frac{1}{2}}$	
2289.41	5	7	43665.8	$16_{4\frac{1}{2}}-602_{3\frac{1}{2}}$	
2282.20	25	75	43803.8	$17_{5\frac{1}{2}}-612_{3\frac{1}{2}}$	
2275.22	5	-----	43938.2	$^6D_{1\frac{1}{2}}-454_{0\frac{1}{2}}$	(. . . 1.40, 1.92)?
2271.64	2	-----	44007.4	$^6D_{2\frac{1}{2}}-471_{1\frac{1}{2}}$	
2271.10	10	12	44017.7	$^6S_{2\frac{1}{2}}-514_{2\frac{1}{2}}$	
2270.23	25	125	44034.8	$14_{4\frac{1}{2}}-588_{5\frac{1}{2}}$	
2266.25	15	80	44112.1	$10_{1\frac{1}{2}}-547_{2\frac{1}{2}}$	
2266.12	15	80	44114.6	$^6D_{3\frac{1}{2}}-488_{3\frac{1}{2}}$	
2265.34	7	35	44129.8	$15_{5\frac{1}{2}}-592_{3\frac{1}{2}}$	
2264.18	8	35	44152.4	$17_{5\frac{1}{2}}-615_{3\frac{1}{2}}$	
2259.66	5	3	44240.7	$^6D_{2\frac{1}{2}}-474_{2\frac{1}{2}}$	
2259.07	10	25	44252.3	$15_{3\frac{1}{2}}-593_{4\frac{1}{2}}$	

TABLE 3.—*Classified lines of W II*—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
2256. 85	12	30	44295. 8	$13_{2\frac{1}{2}}-577_{3\frac{1}{2}}$	
2256. 18	2	6	44308. 9	$14_{2\frac{1}{2}}-592_{3\frac{1}{2}}$	
2255. 71	10	10	44318. 1	$13_{3\frac{1}{2}}-577_{3\frac{1}{2}}$	
2251. 43	18	25	44402. 4	$^4F_{1\frac{1}{2}}-531_{2\frac{1}{2}}$	
2251. 14	30	40	44408. 1	$^6D_{3\frac{1}{2}}-491_{3\frac{1}{2}}$	
2250. 56	3	3	44419. 6	$14_{4\frac{1}{2}}-592_{3\frac{1}{2}}$	
2249. 38	15	12	44442. 9	$^6S_{2\frac{1}{2}}-518_{3\frac{1}{2}}$	(0. 00)
2248. 75	60 _r	100	44455. 3	$^6D_{0\frac{1}{2}}-444_{0\frac{1}{2}}$	(1. 68) 1.53
2248. 27	25 _v	40	44464. 8	$^6D_{3\frac{1}{2}}-491_{4\frac{1}{2}}$	(0. 00)
2246. 64	15	20	44497. 1	$08_{0\frac{1}{2}}-533_{1\frac{1}{2}}$	
2245. 19	25	40 _l	44525. 8	$^6D_{3\frac{1}{2}}-492_{2\frac{1}{2}}$	(0. 00) 1.68
2244. 42	1	3	44541. 1	$14_{4\frac{1}{2}}-593_{4\frac{1}{2}}$	
2240. 53	2?		44618. 5	$^4F_{1\frac{1}{2}}-533_{1\frac{1}{2}}$	
2237. 06	15	100	44687. 6	$16_{4\frac{1}{2}}-612_{3\frac{1}{2}}$	(0. 00) 1. 08
2235. 85	8	8	44711. 7	$^4F_{1\frac{1}{2}}-534_{1\frac{1}{2}}$	
2235. 64	20	30	44716. 0	$^6D_{4\frac{1}{2}}-508_{4\frac{1}{2}}$	
2235. 37	6	60	44721. 4	$15_{3\frac{1}{2}}-598_{3\frac{1}{2}}$	
2232. 28	6	4	44783. 3	$11_{2\frac{1}{2}}-560_{1\frac{1}{2}}$	
2229. 62	75	100	44836. 6	$^6D_{1\frac{1}{2}}-463_{2\frac{1}{2}}$	
2228. 70	5	26	44855. 1	$^6S_{2\frac{1}{2}}-522_{3\frac{1}{2}}$	
2226. 40	8	15	44901. 6	$14_{2\frac{1}{2}}-598_{3\frac{1}{2}}$	(0. 00)
2225. 88	120	150	44912. 0	$^6D_{0\frac{1}{2}}-449_{1\frac{1}{2}}$	(1. 00) 0. 24, 2. 24
2220. 94	40	100	45011. 9	$14_{4\frac{1}{2}}-598_{3\frac{1}{2}}$	(0. 00)
2219. 74	15	12	45036. 3	$16_{4\frac{1}{2}}-615_{3\frac{1}{2}}$	
2216. 03	60	40	45111. 7	$^6D_{2\frac{1}{2}}-482_{2\frac{1}{2}}$	(0. 65) 1. 43
2206. 60	40	200	45304. 4	$08_{0\frac{1}{2}}-541_{1\frac{1}{2}}$	
2204. 49	200	300	45347. 8	$^6D_{4\frac{1}{2}}-514_{3\frac{1}{2}}$	(0. 00) 0. 96
2203. 80	10	25	45362. 0	$14_{4\frac{1}{2}}-602_{3\frac{1}{2}}$	
2200. 70	2	1	45425. 9	$^4F_{1\frac{1}{2}}-541_{1\frac{1}{2}}$	
2199. 17	40	2	45457. 4	$^6D_{0\frac{1}{2}}-454_{0\frac{1}{2}}$	
2198. 68	50	80	45467. 6	$11_{2\frac{1}{2}}-567_{2\frac{1}{2}}$	
2198. 00	8	6	45481. 6	$^6S_{2\frac{1}{2}}-529_{3\frac{1}{2}}$	
2197. 50	8	10	45492. 0	$10_{1\frac{1}{2}}-560_{1\frac{1}{2}}$	
2193. 54	30 _d	40	45574. 1	$11_{2\frac{1}{2}}-568_{2\frac{1}{2}}$	
2189. 50	80	50	45658. 3	$^6D_{2\frac{1}{2}}-488_{3\frac{1}{2}}$	
2189. 36	50	40	45661. 1	$^6D_{1\frac{1}{2}}-471_{1\frac{1}{2}}$	
2187. 82	3	1 _l	45693. 3	$^6S_{2\frac{1}{2}}-531_{2\frac{1}{2}}$	
2186. 73	80 _v	40	45716. 0	$^6D_{4\frac{1}{2}}-518_{3\frac{1}{2}}$	
2180. 70	10	8	45842. 5	$13_{2\frac{1}{2}}-592_{3\frac{1}{2}}$	
2179. 64	8	8	45864. 7	$13_{3\frac{1}{2}}-592_{3\frac{1}{2}}$	
2178. 23	2		45894. 4	$^6D_{1\frac{1}{2}}-474_{2\frac{1}{2}}$	
2177. 56	40 _r ? _v	30	45908. 5	$^6S_{2\frac{1}{2}}-533_{1\frac{1}{2}}$	
2177. 13	3		45917. 5	$^6S_{2\frac{1}{2}}-533_{3\frac{1}{2}}$	
2175. 49	12	2	45952. 1	$^6D_{2\frac{1}{2}}-491_{3\frac{1}{2}}$	
2173. 83	15	10	45987. 4	$13_{3\frac{1}{2}}-593_{4\frac{1}{2}}$	
2173. 55	60	70	45993. 2	$^4F_{1\frac{1}{2}}-547_{2\frac{1}{2}}$	
2169. 95	50	12	46069. 5	$^6D_{2\frac{1}{2}}-492_{2\frac{1}{2}}$	
2167. 19	12	2	46128. 2	$^6D_{4\frac{1}{2}}-522_{2\frac{1}{2}}$	
2166. 32	80 _r ?	80	46146. 8	$^6D_{3\frac{1}{2}}-508_{1\frac{1}{2}}$	
2159. 96	40	3	46282. 6	$10_{1\frac{1}{2}}-568_{2\frac{1}{2}}$	

TABLE 3.—Classified lines of W II—Continued

λ_{air}	Intensity		Wave number	Term combination	Zeeman effect
	Arc	Spark			
2155. 25	3	-----	46383. 7	$14_{4\frac{1}{2}}-612_{5\frac{1}{2}}$	
2153. 15	8	1	46429. 0	$11_{2\frac{1}{2}}-577_{3\frac{1}{2}}$	
2151. 83	6	-----	46457. 3	$13_{3\frac{1}{2}}-598_{3\frac{1}{2}}$	
2139. 64	12	-----	46722. 0	$^6D_{3\frac{1}{2}}-514_{2\frac{1}{2}}$	
2139. 16	30	4	46732. 5	$14_{4\frac{1}{2}}-615_{5\frac{1}{2}}$	
2138. 14	50	30	46754. 8	$^6D_{4\frac{1}{2}}-529_{3\frac{1}{2}}$	
2137. 64	40	5	46765. 8	$^6D_{1\frac{1}{2}}-482_{2\frac{1}{2}}$	
2120. 37	1	-----	47146. 6	$^6D_{3\frac{1}{2}}-518_{3\frac{1}{2}}$	
2118. 87	70	12	47180. 0	$^6D_{0\frac{1}{2}}-471_{1\frac{1}{2}}$	
2118. 34	2	-----	47191. 8	$^6D_{4\frac{1}{2}}-533_{3\frac{1}{2}}$	
2116. 94	40	2	47223. 0	$^6D_{4\frac{1}{2}}-533_{4\frac{1}{2}}$	
2115. 66	2	-----	47251. 6	$08_{0\frac{1}{2}}-560_{1\frac{1}{2}}$	
2101. 96	20	-----	47559. 5	$^6D_{3\frac{1}{2}}-522_{3\frac{1}{2}}$	
2094. 72	120	15	47723. 8	$^6D_{1\frac{1}{2}}-492_{2\frac{1}{2}}$	
2086. 58	5	-----	47910. 0	$^6D_{4\frac{1}{2}}-540_{4\frac{1}{2}}$	
2083. 70	10	-----	47976. 2	$11_{2\frac{1}{2}}-592_{3\frac{1}{2}}$	
2074. 64	20	-----	48185. 7	$^6D_{3\frac{1}{2}}-529_{3\frac{1}{2}}$	
2071. 22	30	1	48265. 3	$^6D_{2\frac{1}{2}}-514_{2\frac{1}{2}}$	
2065. 58	20r?	10	48397. 0	$^6D_{3\frac{1}{2}}-531_{2\frac{1}{2}}$	
2058. 30	12	20b	48568. 2	$11_{2\frac{1}{2}}-598_{3\frac{1}{2}}$	
2056. 01	2	6	48622. 2	$^6D_{3\frac{1}{2}}-533_{3\frac{1}{2}}$	
2054. 66	15	2	48654. 2	$^6D_{3\frac{1}{2}}-533_{4\frac{1}{2}}$	
2053. 11	6b	8	48690. 9	$^6D_{2\frac{1}{2}}-518_{3\frac{1}{2}}$	
2048. 04	5	50b	48811. 4	$^6D_{4\frac{1}{2}}-549_{5\frac{1}{2}}$	
2035. 87	5	40b	49103. 2	$^6D_{2\frac{1}{2}}-522_{3\frac{1}{2}}$	
2029. 99	5	20	49245. 4	$^6D_{4\frac{1}{2}}-553_{4\frac{1}{2}}$	
2026. 06	8	30v	49340. 9	$^6D_{3\frac{1}{2}}-540_{4\frac{1}{2}}$	
2021. 43	-----	1b	49453. 9	$^6S_{2\frac{1}{2}}-568_{2\frac{1}{2}}$	
2010. 21	3	8	49729. 9	$^6D_{2\frac{1}{2}}-529_{3\frac{1}{2}}$	
2002. 56	-----	1	49919. 8	$^6D_{1\frac{1}{2}}-514_{2\frac{1}{2}}$	
2001. 70	3	8	49941. 3	$^6D_{2\frac{1}{2}}-531_{2\frac{1}{2}}$	
1999. 82	3	5	49988. 2	$^6D_{3\frac{1}{2}}-547_{2\frac{1}{2}}$	
1989. 40	2	5	50250. 0	$^6D_{2\frac{1}{2}}-534_{1\frac{1}{2}}$	
1972. 63	2	4	50677. 1	$^6D_{3\frac{1}{2}}-553_{4\frac{1}{2}}$	
1961. 43	2	5	50966. 4	$^6D_{2\frac{1}{2}}-541_{1\frac{1}{2}}$	

The observed Zeeman effects in the last column of table 3 are those measured on recent Bureau plates; or are taken from Jack⁷ or Beining,⁸ in which case they are followed by the letters J or Be, respectively. Jack's observations have been reduced by 7 percent and Beining's have been corrected according to Catalán and Poggio.⁹ Typical unresolved patterns have been described by Greek letters as follows: Doublet shaded outward, α_1 ; doublet shaded inward, α_2 ; doublet shaded symmetrically, β . The observed patterns of table 3 may be compared with the theoretical patterns derived from the

⁷ R. Jack, Ann. Physik [4] **28**, 1032 (1909).⁸ H. Beining, Z. Physik **42**, 153 (1927).⁹ M. A. Catalán and F. Poggio, Anales. soc. españ. fis. quim. **32**, 265 (1934).

Landé g -values by reference to the extensive tables given by Kiess and Meggers.¹⁰

The designation of the term ${}^4F_{1\frac{1}{2}}$ in table 1 is to be regarded as provisional. The g -values given for higher even levels are only preliminary values and probably have an average error of at least 0.1; but, on the basis of the data, they are fairly consistent. The identification of the level $08_{0\frac{1}{2}}$ with ${}^4P_{0\frac{1}{2}}$, and the level $13_{0\frac{1}{2}}$ with ${}^4D_{0\frac{1}{2}}$ is conjectural, but if correct, all three quartet terms, 4P , 4D , and

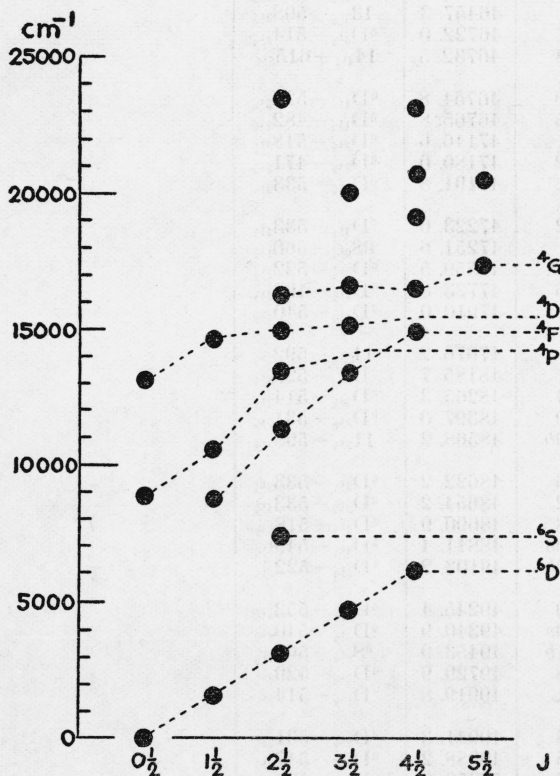


FIGURE 1.—Low and metastable terms of W II with probable multiplet arrangement.

Since it also represents the transition ${}^6D_{4\frac{1}{2}}-514_{5\frac{1}{2}}$, this line is in all probability the true *raie ultime* of W II.

2. NEW LEVELS AND g -VALUES FOR THE ARC SPECTRUM W I

After the discovery of the low terms of W I, Laporte has continued the analysis of this spectrum with the collaboration of J. E. Mack. I have had the opportunity of being associated with Professor Mack in this work for several months, at the University of Wisconsin, and have had access to all their results. When the new wave-length measurements described above had been completed, some of the levels that had appeared to be doubtful on the basis of the older data,

4F , can be filled out from the neighboring terms in a very simple manner and with regular intervals. All the levels of 4G are next in line, ending with $17_{5\frac{1}{2}}$. These conjectures are illustrated in figure 1. The four quartets would account for all the unidentified levels below $19_{4\frac{1}{2}}$.

According to the rule of Meggers and Scribner,¹¹ the *raie ultime* of W II should be represented by the term combination $5d^46s\ {}^6D_{4\frac{1}{2}}-5d^46p\ {}^6F^o_{5\frac{1}{2}}$. The theoretical Zeeman effect for this transition in LS-coupling is (0.05, 0.15,) **1.00**, 1.10, The line at 2204.49 Å has the observed Zeeman pattern (0.00) 0.96, and it has outstanding intensity in both arc and spark sources.

¹⁰ C. C. Kiess and W. F. Meggers, BS J. Research **1**, 641 (1928) RP23.

¹¹ W. F. Meggers and B. F. Scribner, NBS J. Research **13**, 657 (1934) RP732.

were verified, and others were rejected. This brought the number of odd levels known in 1934 to 170.

TABLE 4.—New levels for the arc spectrum W I

<i>J</i>	Term value	Remarks	<i>J</i>	Term value	Remarks
2-----	20, 983. 08	(Even)	4-----	38, 001. 10	
0-----	41, 965. 14			40, 233. 93	
	49, 529. 55			40, 583. 01	
1-----	45, 374. 02			43, 720. 86	
	48, 389. 95			47, 689. 29	
	49, 443. 66			49, 148. 00	(?)
	53, 042. 02			50, 284. 72	
	54, 941. 06			52, 059. 74	
	55, 859. 36			52, 992. 70	
				53, 118. 28	
2-----	21, 448. 70			54, 118. 78	(5?)
	33, 943. 98			54, 911. 63	LM give $J=3$ or 4
	35, 311. 46			55, 043. 36	
	49, 151. 92			55, 867. 28	
	51, 182. 36	(?)		55, 955. 36	
	51, 693. 90			56, 174. 67	
	52, 064. 15			56, 255. 70	
	52, 152. 62			56, 831. 64	
	53, 959. 38			57, 803. 66	
	54, 859. 22			58, 777. 78	
	55, 032. 72			59, 171. 70	
	55, 084. 05			60, 385. 01	
	55, 619. 70		5-----	26, 676. 38	
	55, 835. 20			45, 789. 08	
	59, 422. 00			46, 506. 32	
	59, 999. 10			50, 806. 06	
3-----	42, 514. 09			51, 290. 73	
	49, 270. 17			52, 395. 46	
	51, 072. 24			52, 774. 10	
	52, 015. 30			53, 194. 25	
	52, 255. 78	LM give $J=4$		54, 310. 30	
	52, 943. 50			55, 009. 20	
	53, 345. 60	LM give $J=4$		55, 455. 28	
	53, 390. 48			55, 492. 18	
	54, 556. 50			55, 795. 60	
	55, 389. 32			55, 987. 86	
	55, 546. 08			56, 280. 46	
	56, 108. 51			57, 143. 47	
	56, 484. 30			57, 560. 80	
	56, 717. 14			58, 179. 37	
	58, 091. 56			58, 562. 62	
	58, 206. 00			58, 903. 94	
	58, 644. 00			59, 263. 60	
				59, 673. 30	
			6-----	38, 203. 04	
				52, 855. 95	
				53, 228. 38	
				54, 733. 32	
				56, 526. 58	
				57, 919. 12	
				59, 128. 76	
				59, 410. 48	
			7-----	43, 411. 40	(?)

Further analysis of the new data yielded the 88 new odd levels given in table 4, as well as one even level. Later it was learned that a number of the new levels were independently discovered by Poggio¹² with some differences of J -value. The question-marked levels require additional observations in other regions of the spectrum in order to be definitely established.

New g -values for 37 odd levels, established by Laporte and Mack, are given in table 5. The terms are designated by the first three figures of their numerical values with subscripts denoting their inner quantum numbers. The Zeeman patterns measured in the new region were almost exclusively combinations with the low D and S terms. A few corrections to the J -values in table 4 may be necessary when more Zeeman effects of weaker lines become available.

A considerable number of arc lines remain unclassified, some of which are quite intense and others of which show absorption in the under-water spark¹³ or electric furnace.¹⁴ The origin of the dozen absorption lines that remain unaccounted for perhaps lies in relatively high levels with J -value greater than the 7D_4 , as was indicated in a previous note.¹⁵ Reobservation of the region from 3100 to 5500 Å will help to give a basis for classifying these lines.

TABLE 5.—*New g -values for arc levels*

Term symbol	g -value	Term symbol	g -value	Term symbol	g -value
361 ₁	1. 63	408 ₂	1. 2	438 ₃	1. 21
377 ₁	0. 8	415 ₂	1. 02	440 ₃	1. 14
391 ₁	0. 90	417 ₂	1. 20	463 ₃	1. 3
396 ₁	1. 4	419 ₂	0. 96	382 ₄	1. 28
404 ₁	1. 5	439 ₂	1. 33	387 ₄	1. 07
407 ₁	1. 25	450 ₂	1. 20	397 ₄	1. 18
422 ₁	1. 72	376 ₃	1. 10	402 ₄	1. 32
425 ₁	1. 1	380 ₃	1. 1	405 ₄	1. 26
438 ₁	1. 48	396 ₃	1. 56	411 ₄	1. 30
366 ₂	1. 6	422 ₃	1. 36	452 ₄	1. 08
374 ₂	1. 24	426 ₃	1. 18	466 ₄	1. 3
390 ₂	1. 31	434 ₃	1. 24	469 ₄	1. 3
				465 ⁵	1. 4

The work described above could not have advanced to its present state without the advice and assistance of others. It is a pleasure to acknowledge here my indebtedness to Rev. Joseph F. Carroll, S. J., of Marquette University, for permission to work in his laboratory and to express my appreciation for the many courtesies he has extended to me. The assistance of Prof. J. E. Mack with the Zeeman and other calculations, and that of W. F. Meggers with the term analysis, is gratefully acknowledged. Finally, to C. C. Kiess special thanks are due for making most of the plates used in this investigation and for his constant aid and encouragement throughout.

WASHINGTON, March 10, 1938.

¹² F. Poggio, *Anales soc. espafi. fis. quim.* **33**, 171 (1935).

¹³ W. F. Meggers, Unpublished National Bureau of Standards observations.

¹⁴ A. S. King, *Astrophys. J.* **75**, 379 (1932).

¹⁵ D. D. Laun, *Phys. Rev.* **48**, 572 (1935).